TABLE E-5
MAMMAL TOXICITY REFERENCE VALUES

	F	Basis for Toxicity Refer	rence Value (TRV)			
Compound	Duration and Endpoint <sup>a</sup>	Test Organism	Dose <sup>b</sup>	Uncertainty Factor <sup>c</sup>	TRV	Reference and Explanation <sup>d</sup>
Dioxins and furans (	(Φg/kg BW/day)					
Total PCDDs	Chronic (multigenerational ) no observed adverse effect level (NOAEL) for reproduction	Rat	0.001	Not applicable	0.001	Murray and others (1979). TRV based on toxicity of 2,3,7,8-TCDD.
Total PCDFs	Acute (single dose) NOAEL	Guinea Pig	0.33	0.01 <sup>e</sup>	0.0033	Moore, McConnell, Dalgard, and Harris (1979). TRV based on toxicity of 2,3,7,8-TCDF.
Polycyclic aromatic	hydrocarbons (PAH)	(Φg/kg BW/day)				
Total high molecular weight (HMW) PAH		-			100	TRV based on benzo(a)pyrene toxicity. Total HMW PAH TRV should be used if TRVs not available for all individual HMW PAH compounds.
Benzo(a)pyrene	Acute (10 days) lowest observed adverse effect level (LOAEL) (reproductive effects)	Mouse	10,000	0.01	100	Mackenzie and Angevine (1981).

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Compound	Duration and Endpoint <sup>a</sup>	Test Organism	Dose <sup>b</sup>	Uncertainty Factor <sup>c</sup>	TRV	Reference and Explanation <sup>d</sup>
Benzo(a)anthracene	Chronic (16 months) LOAEL (gastrointestinal effects)	Mouse	29,000	0.1	2,900	Bock and King (1959).
Benzo(b)fluor- anthene		-				Applicable TRV or surrogate not identified.
Benzo(k)fluor- anthene		-				Applicable TRV or surrogate not identified.
Chrysene		ł	-1-			Applicable TRV or surrogate not identified.
Dibenz(a,h)anthracene	Subchronic (15 days) LOAEL (reduced growth rate)	Rat	200	0.01°	2	Haddow, Scott, and Scott (1937).
Indeno(1,2,3-cd)pyrene		ł	-1-			Applicable TRV or surrogate not identified.
Polychlorinated biph	nenyls (PCB) (Фg/kg	BW/day)				•
Aroclor 1016	Subchronic (14.5 weeks) LOAEL (mortality)	Mink	114	0.01	1.14	Aulerich, Bursian, Breslin, Olson, and Ringer (1985). TRV based on toxicity of 3,4,5-hexachlorobiphenyl.

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MAMMAL TOXICITY REFERENCE VALUES

	F	Basis for Toxicity Refe				
Compound	Duration and Endpoint <sup>a</sup>	Test Organism	Dose b	Uncertainty Factor <sup>c</sup>	TRV	Reference and Explanation <sup>d</sup>
Aroclor 1254	Subchronic (14.5 weeks) LOAEL (mortality)	Mink	114	0.01	1.14	Aulerich, Bursian, Breslin, Olson, and Ringer (1985). TRV based on toxicity of 3,4,5-hexachlorobiphenyl.
Nitroaromatics (Φg/	kg BW/day)					
1,3-Dinitrobenzene	Chronic (16 weeks) NOAEL	Rat	1,248	1.0	1,248	Cody, Witherup, Hastings, Stemmer, and Christian (1981).
2,4-Dinitrotoluene	Chronic (24 months) NOAEL	Dog	700	1.0	700	Ellis, Hagensen, Hodgson, Minor, Hong, Ellis, Girvin, Helton, Herndon, and Lee (1979).
2,6-Dinitrotoluene	Acute (single dose) LOAEL (mortality)	Dog	4,000	0.01	400	Lee and others (1976).
Nitrobenzene						Applicable TRV or surrogate not identified.
Pentachloronitro- benzene	Chronic (2 years) NOAEL	Mouse	0.475	1.0	0.475	National Toxicology Program (NTP) (1987).
2,4,6- Trinitrotoluene	Chronic (6 months) NOAEL (Decreased weight gain and anemia)	Dog (Beagle)	200	Not applicable	200	Johnson and McAtee (2000). This source reviewed all available literature relevant to the development of a mammal TRV and follows U.S. Army guidance for the development of wildlife TRVs (USCHPPM).

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	I	Basis for Toxicity Refe	rence Value (TRV)						
Compound	Duration and Endpoint <sup>a</sup>	Test Organism	Dose <sup>b</sup>	Uncertainty Factor <sup>c</sup>	TRV	Reference and Explanation <sup>d</sup>			
Phthalate esters (Фд	/kg BW/day)								
Bis(2- ethylhexyl)phthalate	Chronic (2 years) NOAEL	Rat	60,000	1.0	60,000	Carpenter, Weil, and Smyth, Jr. (1953).			
Di-n-butyl phthalate	Chronic (105 days) NOAEL (Reduced litter size and survival)	CD-1 Mice	550,000	0.1	55,000	Lamb and others (1987), as cited in Sample and others (1996). Benchmark value divided by an uncertainty factor of 10 in order to account for unknown intraclass variability.			
Diethyl phthalate	Chronic (105 days) NOAEL (Reproductive effects)	CD-1 Mice	4,583,000	0.1	458,300	Lamb and others (1987), as cited in Sample and others (1996). Benchmark value divided by an uncertainty factor of 10 in order to account for unknown intraclass variability.			
Di(n)octyl phthalate	Chronic (105 days) NOAEL	Mouse	7,500,000	1.0	7,500,000	Heindel, Gulati, Mounce, Russell, and Lamb (1989).			
Volatile organic com	Volatile organic compounds (Φg/kg BW/day)								
Acetone	Subchronic (90 days) NOAEL	Albino Rat, male	100,000	0.1	10,000	U.S. EPA (1986).			

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Compound	Duration and Endpoint <sup>a</sup>	Test Organism	Dose <sup>b</sup>	Uncertainty Factor <sup>c</sup>	TRV	Reference and Explanation <sup>d</sup>
Acrylonitrile	Chronic (2 years) LOAEL (lesions and other organ effects)	Rat	4,600	0.1	460	Quast and others (1980).
Bromoform	Chronic (105 days) NOAEL (histological effects in reproductive tissues)	Rat	200,000	0.1	20,000	NTP (1988), as cited in Agency for Toxic Substances and Disease Registry (ATSDR) (1990). Benchmark value divided by an uncertainty factor of 10 in order to account for unknown intraclass variability.
Chloroform	Chronic (80 weeks) NOAEL	Mouse	51,429	1.0	51,429	Roe, Palmer, Worden, and Van Abbe (1979).
Crotonaldehyde	Acute LD50	Rat	160	0.01	1.6	Patty (1976).
1,4-Dioxane	Chronic (23 months) LOAEL (lung tumors)	Guinea Pig	1,070	0.1	107	Hoch-Ligeti and Argus (1970).
Ethylbenzene						Applicable TRV or surrogate not identified.
Formaldehyde	Acute (single dose) LOAEL (mortality)	Rat	230,000	0.01	2,300	Tsuchiya, Hayashi, Onodera, and Hasegawa (1975).

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Compound	I	Basis for Toxicity Refer				
	Duration and Endpoint <sup>a</sup>	Test Organism	Dose <sup>b</sup>	Uncertainty Factor <sup>c</sup>	TRV	Reference and Explanation <sup>d</sup>
n-Hexane	Acute (single dose) LOAEL (mortality)	Mice	238,000,000	0.001	238,000	Registry of Toxic Effects of Chemical Substances (RTECS), which cites a source in "Drug and Chemical Toxicology" (1980). Acute LOAEL divided by an uncertainty factor of 100 to approximate a chronic NOAEL value and an uncertainty factor of 10 in order to account for unknown intraclass variability.
1,1,2,2- Tetrachloroethane	Chronic (6 weeks) NOAEL (Decrease in body weight gain)	Osborne-Mendel, female	56,000	0.1	5,600	National Cancer Institute (NCI) (1978), as cited in ATSDR (1996). Benchmark value divided by an uncertainty factor of 10 in order to account for unknown intraclass variability.
Vinyl chloride	Chronic (2 years) LOAEL (vinyl chloride)	Rat	1,700	0.1	170	Feron, Hendricksen, Speek, Til, and Spit (1981).

Semi-volatile organic compounds (Φg/kg BW/day)

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	F	Basis for Toxicity Refer				
Compound	Duration and Endpoint <sup>a</sup>	Test Organism	Dose <sup>b</sup>	Uncertainty Factor <sup>c</sup>	TRV	Reference and Explanation <sup>d</sup>
Benzoic acid	Chronic (long- term) NOAEL (reproductive effects)	Rat	50,000	0.1	5,000	Marquardt (1960), as cited in U.S. EPA's Integrated Risk Information System (IRIS). Benchmark value divided by an uncertainty factor of 10 in order to account for unknown intraclass variability.
Benzyl alcohol	Acute (single dose) LD50 (mortality)	Rat	1,230,000	0.001	1,230	Registry of Toxic Effects of Chemical Substances (RTECS), which cites a source in "Drug and Chemical Toxicology" (1980). Acute LD50 divided by an uncertainty factor of 100 to approximate a chronic NOAEL value and an uncertainty factor of 10 in order to account for unknown intraclass variability.
Inorganics (mg/kg F	BW/day)					
Aluminum	Chronic (>1 year) LOAEL (mortality)	Rat	0.66	0.1	0.066	Schroeder and Mitchner (1975).
Antimony	Chronic (4 years) LOAEL (mortality)	Rat	0.66	0.1	0.066	Schroeder, Mitchner, and Nasor (1970).

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	F	Basis for Toxicity Refe	rence Value (TRV)			
Compound	Duration and Endpoint <sup>a</sup>	Test Organism	Dose <sup>b</sup>	Uncertainty Factor <sup>c</sup>	TRV	Reference and Explanation <sup>d</sup>
Arsenic	Chronic (2 years) NOAEL	Dog	1.25	1.0	1.25	Byron, Bierbower, Brouwer, and Hansen (1967).
Barium	Chronic (16 months) NOAEL	Rat	0.51	1.0	0.51	Perry and others (1983).
Beryllium	Chronic (>1 year) NOAEL	Rat	0.66	1.0	0.66	Schroeder and Mitchner (1975).
Boron	Chronic (2 years) NOAEL	Rat	28,000	0.1	2,800	Weir and Fisher (1972), as cited in Sample and others (1996). Benchmark value divided by an uncertainty factor of 10 in order to account for unknown intraclass variability.
Cadmium	Chronic (>150 days) LOAEL (mortality)	Mouse	1.92	0.1	0.19	Schroeder and Mitchner (1971).
Chromium (hexavalent)	Chronic (1 year) NOAEL	Rat	2.4	1.0	2.4	MacKenzie and others (1958).
Copper	Subchronic (183 days) NOAEL	Mink	6.85	0.1	0.685	Aulerich, Ringer, Bleavins, and Napolitano (1982).
Total Cyanide	Chronic (2 years) NOAEL	Rat	15	1.0	15	Howard and Hanzal (1955).

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Compound	Duration and Endpoint <sup>a</sup>	Test Organism	Dose <sup>b</sup>	Uncertainty Factor <sup>c</sup>	TRV	Reference and Explanation <sup>d</sup>
Lead	Chronic (>150 days) LOAEL (mortality)	Mouse	4.79	0.1	0.48	Schroeder and Mitchner (1971).
Mercury	Chronic (6 months) NOAEL (reproduction)	Rat	1.01	1.0	1.01	Aulerich, Ringer, and Iwamoto (1974).
Methyl mercury	Subchronic (93 days) NOAEL	Rat	0.032	1.0	0.032	Verschuuren, Kroes, Den Tonkelaar, Berkvens, Helleman, Rauws, Schuller, and Van Esch (1976).
Nickel	Chronic (2 years) NOAEL	Rat	8	1.0	8	Ambrose, Larson, Borzelleca, and Hennigar, Jr. (1976).
Selenium	Chronic (>150 days) LOAEL (mortality)	Mouse	0.58	0.1	0.058	Schroeder and Mitchner (1971).
Silver	Chronic (125 days) LOAEL (hypoactivity)	Mouse	3.75	0.1	0.375	Rungby and Danscher (1984).
Thallium	Subchronic (60 days) LOAEL (testicular function)	Rat	0.27	0.01 <sup>h</sup>	0.0027	Formigli, Scelsi, Poggi, Gregotti, Di Nucci, Sabbioni, Gottardi, and Manzo (1986).
Zinc	Subchronic (13 weeks) NOAEL	Mouse	104	0.1	10.4	Maita and others (1981).

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Compound	Duration and Endpoint <sup>a</sup>	Test Organism	Dose <sup>b</sup>	Uncertainty Factor <sup>c</sup>	TRV	Reference and Explanation <sup>d</sup>
Other compounds (	Φg/kg BW/day)					
Cyclotrinitra- minemethylene (RDX)	Chronic (2 years) NOAEL (Reproductive effects)	B6C3F1 Mice	7,000	0.1	700	Lish and others (1984), as cited in Talmage and others (1999). Benchmark value divided by an uncertainty factor of 10 in order to account for unknown intraclass variability.
Decane						Applicable TRV or surrogate not identified.
GB (Sarin)	Subchronic (90 days) LOAEL (Decrease in plasma and RBC- AchE activity)	CD Rats	0.075	0.01	0.0008	Bucci and Parker (1992), as cited in Opresko and others 1998.
VX	Subchronic (56 days) LOAEL (Decrease in whole blood ChE)	Yearling ewes	0.0001	0.01	0.000001	Rice and others (1971), as cited in Opresko and others 1998.
Sulfur mustard	Subchronic (108 days) LOAEL (Acanthosis and hyperplasia of epilethial tissue in forestomach)	Sprague-Dawley Rats	0.03	0.01	0.0003	Sasser and others (1989), as cited in Opresko and others 1998.

## **TABLE E-5**

## MAMMAL TOXICITY REFERENCE VALUES

## Notes:

- a The duration of exposure is defined as chronic if it represents about 10 percent or more of the test animal=s lifetime expectancy. Acute exposures represent single exposure or multiple exposures occurring within about two weeks or less. Subchronic exposures are defined as multiple exposures occurring for less than 10 percent of the test animal=s lifetime expectancy but more that 2 weeks.
- b Reported values which were dose in food or diet were converted to dose based on body weight and intake rate using Opresko, Sample, and Suter 1996.
- c Uncertainty factors are used to extrapolate a reported toxicity value to a chronic NOAEL TRV. The TRV was calculated by multiplying the regulatory or reported toxicity value by the uncertainty factor.
- d The references refer to the study or studies from which the endpoint and doses were identified. Complete reference citations are provided at the end of this appendix.
- e Best professional judgement used to identify uncertainty factor. Factors evaluated include test duration, ecological relevance of endpoint, experimental design, and availability of toxicity data.